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**OOAMA**

## AIRMUNITIONS REPORT

REMOVAL AND REPLACEMENT  
PROCEDURE FOR  
NOZZLE CLOSURE,  
IM99B BOOST MOTOR



REMOVAL AND REPLACEMENT PROCEDURE

FOR

NOZZLE CLOSURE, IM99B BOOST MOTOR

by

Don F. Woods

PUBLICATION REVIEW

This report has been reviewed and is approved



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APRIL 1963

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ADMINISTRATIVE DATA

PURPOSE OF REMOVAL AND REPLACEMENT PROCEDURE:

This procedure was developed in order to provide an approved procedure for removal and replacement of damaged IM99B Boost Motor nozzle closures.

DRAWINGS AND SPECIFICATIONS:

Thiekol Drawing CR 33905, Closure

Thiekol Drawing CR 30034-A, Plug Assy

MIL-S-8784 (FSN 8030-881-3933 Class A-1/2) Sealing Compound, Aluminum, integral fuel tanks and fuel cell cavities, low adhesion, accelerator required.

Wrench Assy Closure Plug (P/N (USAF) 61C33791)

SECURITY CLASSIFICATION:

Unclassified

DATE PROCEDURE COMPLETED:

February 1963

PROCEDURE EVALUATED BY:

OOAMA (OOYET - 2705th Airmunitions Wing)

Test Director - Richard O. Miller, Captain, USAF

Project Officer - Don F. Woods, Mechanical Engineer

Project Directive - M-2-1185-Y

ABSTRACT

The nozzle opening of the IM99B Boost Motor (M51 Rocket Motor) is sealed by a polyurethane foam closure bonded to the nozzle expansion cone. Occasionally the closure is damaged and must be removed and replaced.

The removal procedure consists of very carefully chiseling away the polyurethane foam until the bonding material is exposed. The bonding material (polysulfide sealing compound) is then removed by peeling back with the fingers and by sanding.

The closure is replaced by applying a commercial sealing compound to the closure and nozzle expansion cone, inserting the closure into the cone and allowing the sealing compound to cure.

Field or depot removal and replacement of damaged closures is practical. No special tools or equipment is required. Necessary material and parts are available through normal supply channels.

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## INTRODUCTION

The nozzle opening of the IM99 Boost Motor (M51 Rocket Motor) blast tube and nozzle assembly (Figure 1) is sealed with a polyurethane closure assembly (Figure 2) bonded to the nozzle expansion cone. The purpose of the seal is to control humidity in the motor, to prevent foreign objects from entering the motor and to allow a low pressure check of the motor.

The closure assembly is made up of two parts: the closure, which is bonded to the nozzle expansion cone and the plug which threads into the closure and contains a desiccant chamber, breathing port and humidity indicator. If the closure is damaged to the extent that it is no longer serviceable, it must be replaced.

This procedure describes the method to be used for field or depot removal and replacement of the nozzle closure. This procedure may be used with the blast tube and nozzle removed from the loaded case or with the blast tube and nozzle attached to the loaded case (complete motor assembly). This procedure can be followed with the blast tube and nozzle in the horizontal position or in the vertical position with the nozzle up.

## CAUTION

If the nozzle closure is removed and replaced, with the blast tube and nozzle attached to a live loaded case, all applicable safety regulations will be observed when working on or near the boost motor.

## DESCRIPTION

### CLOSURE

The nozzle closure (Figure 3) consists of a polyurethane foam ring bonded to the nozzle expansion cone with sealing compound. The ring is tapered on the edge and is approximately 14.6 inches in diameter and three inches thick. The center is threaded for acceptance of a plug. The closure has a groove 0.75 inch deep, cut into the side, to insure failure at motor ignition by shearing of the closure wall rather than by bond failure of the sealing compound.

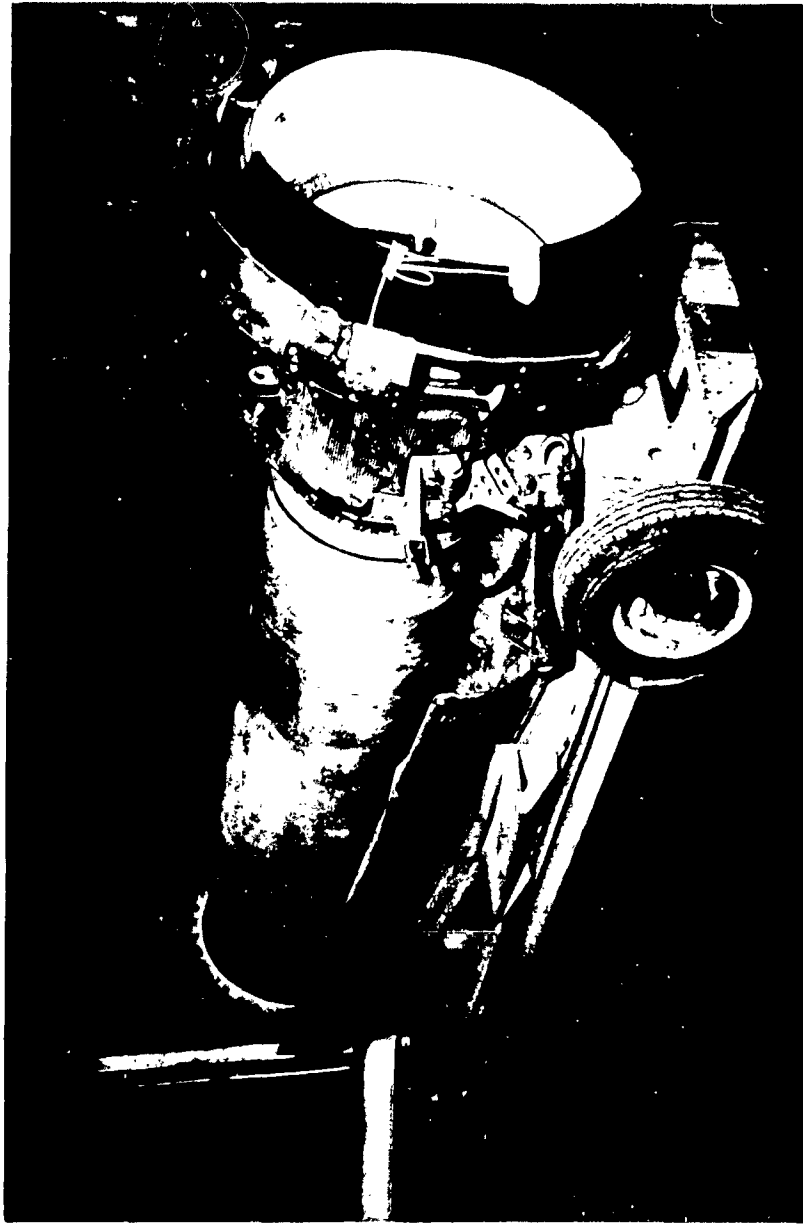


FIGURE 1. Elast Tube and Nozzle Assy - M51 Rocket Motor.

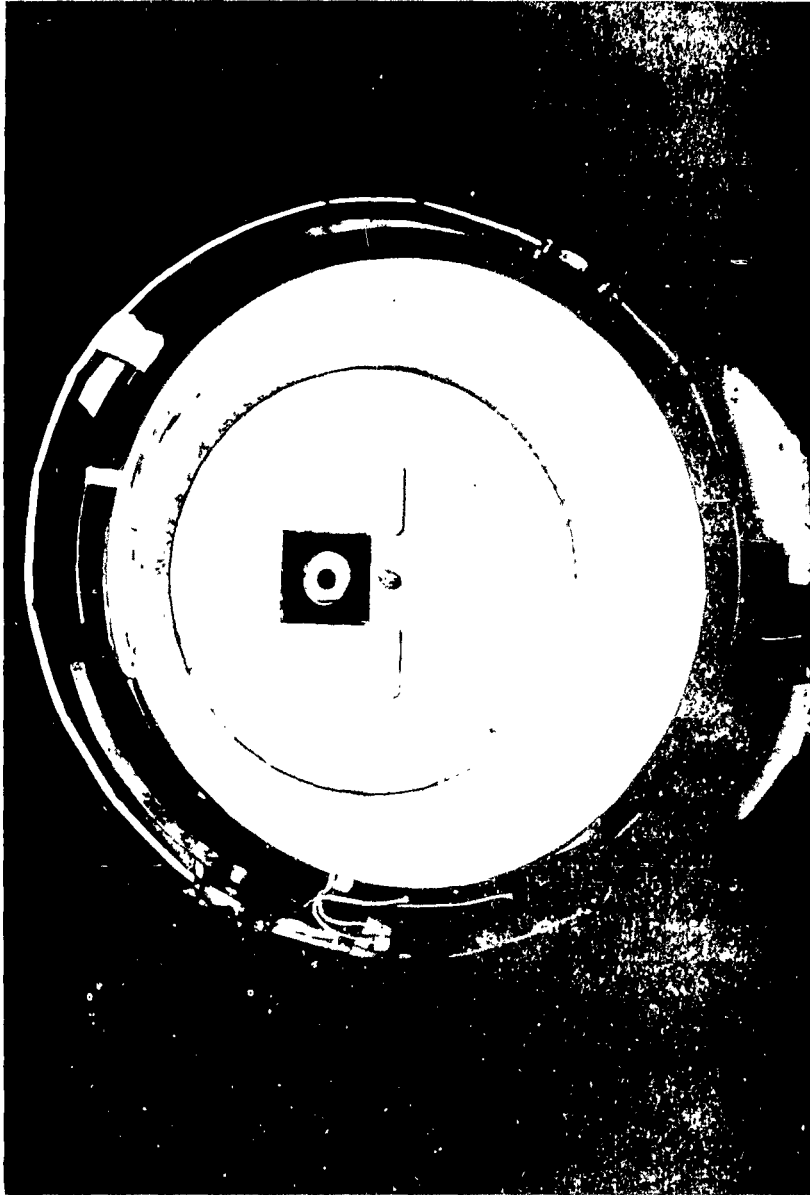


FIGURE 2. Nozzle Closure Assy - M51 Rocket Motor.

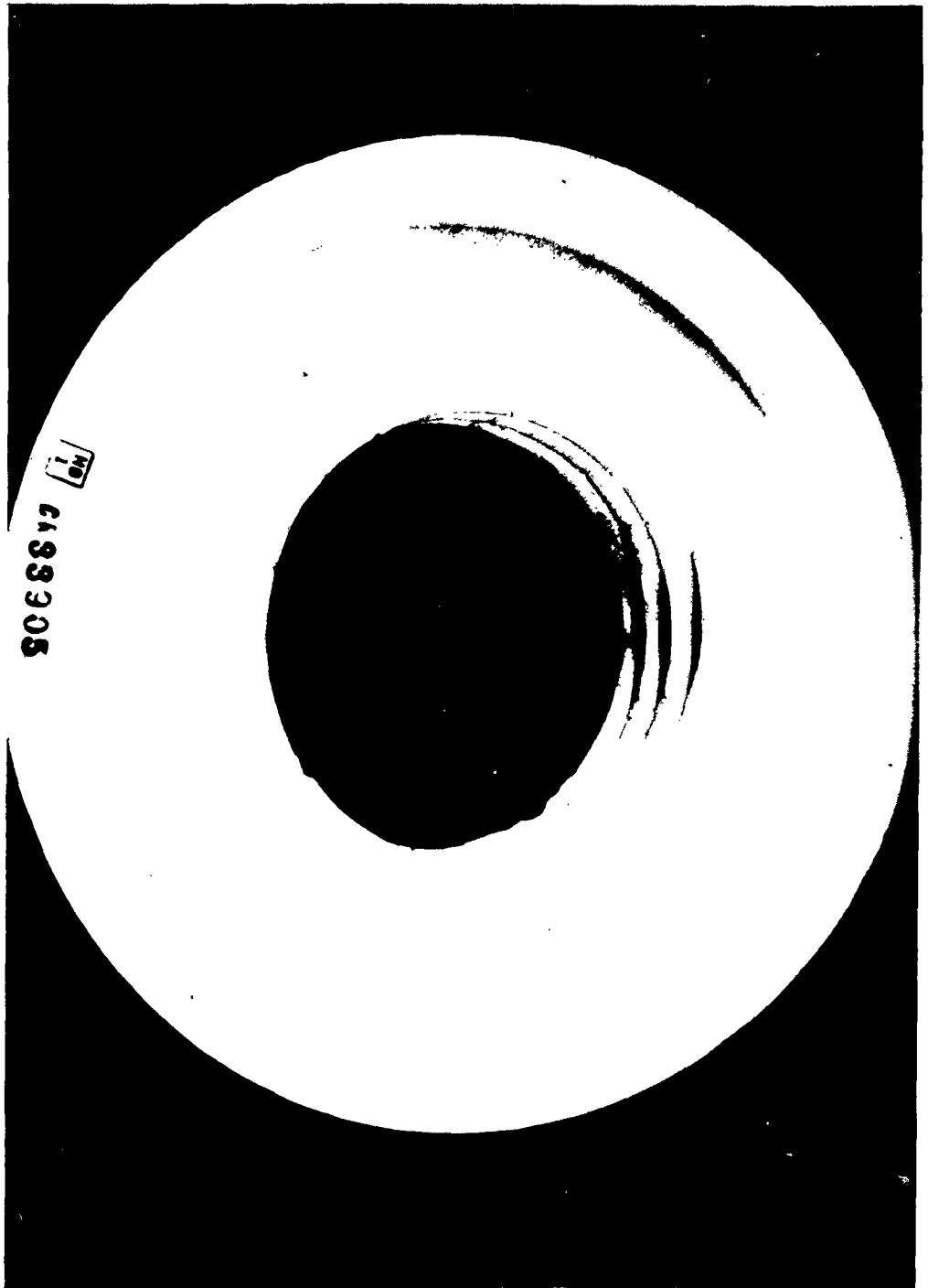


FIGURE 3. Nozzle Closure - M51 Rocket Motor.

## PLUG

The plug is made from polyurethane foam. It is threaded for insertion into the closure and is about 8.5 inches long and 10 inches in diameter. The plug contains a chamber to hold desiccant and is equipped with a humidity indicator. The plug is of the breathing type and is equipped with a vent port. The vent port is also used as a pressure fitting during low pressure check out of the motor.

## REMOVAL PROCEDURE

The removal of a nozzle closure will require between 8 and 16 man-hours.

Secure the jetevator rings tightly to prevent them from slipping and pinching or crushing the fingers.

Cover the entire inner surface of the nozzle expansion cone with one layer of masking tape to decrease the possibility of accidental damage to the rokode coating. (The photographs in this report do not show this tape as this step was included after the closure had been removed and replaced and the methods employed reviewed for improved procedures.)

If the nozzle closure plug is not damaged or can be removed in the usual manner, unscrew it from the closure, using a nozzle closure plug wrench, P/N 61C33791 (Figures 4 and 5). Before unthreading, insert a thin flexible putty knife or spatula between the plug gasket and closure to break any bond. Run the spatula 360 degrees around the joint.

If the plug is damaged and cannot be unthreaded, cut it out, along with the closure, as follows:

Using a carpenters chisel (1/2 inch by 1 inch wide) and mallet (Figure 6), cut the closure away from the nozzle exit cone until the black sealing compound is exposed (Figures 7 and 8).

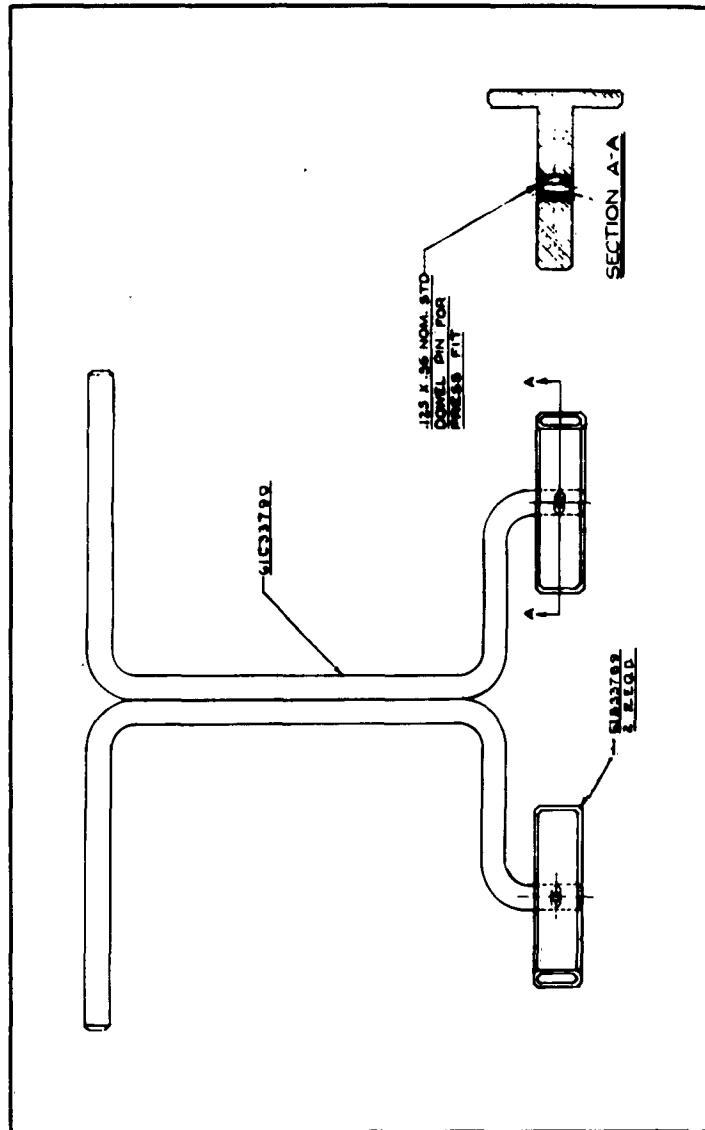


FIGURE 4. OAMA Dwg No. 61C33791 Wrench Assembly - Closure Plug, XM-51.

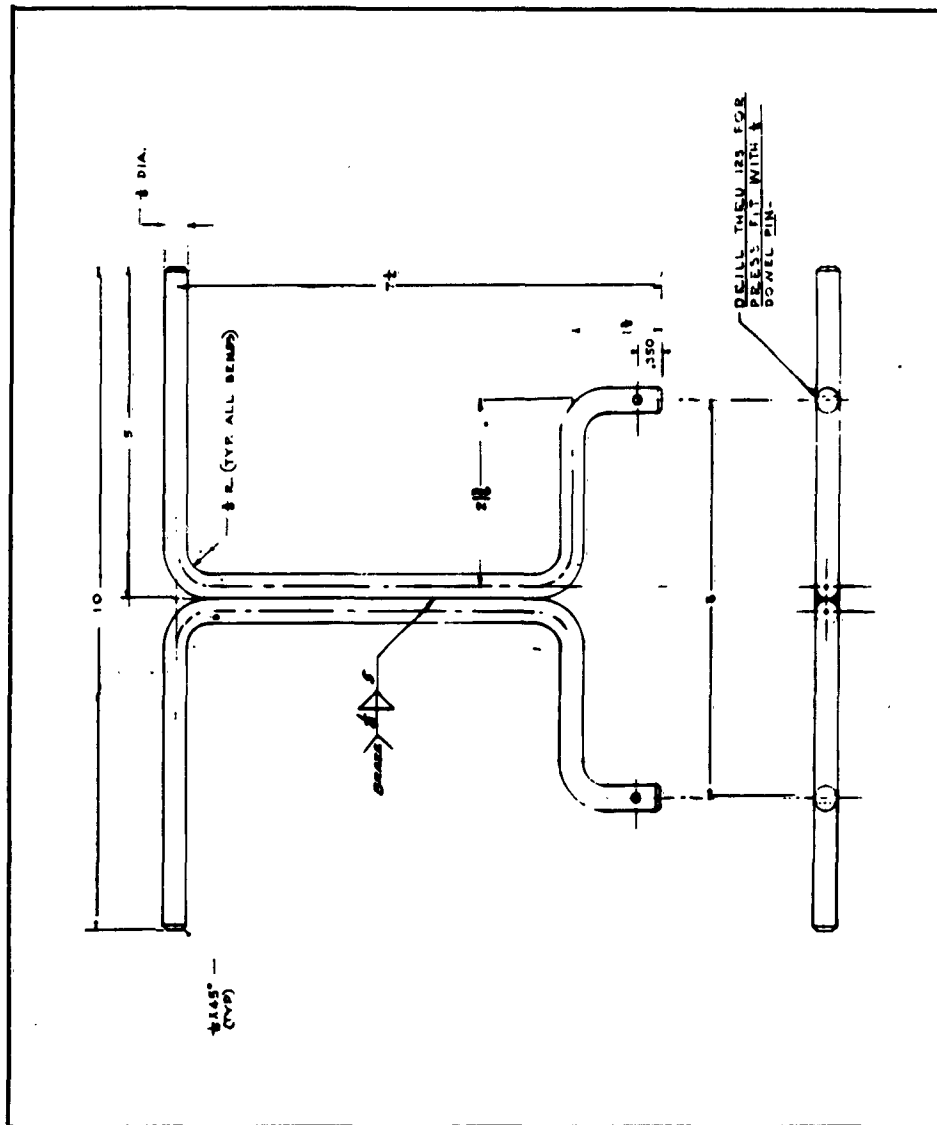


FIGURE 5. OOAMA Dwg No. 61033790 Handle - Wrench, Closure Plug, XM-51.

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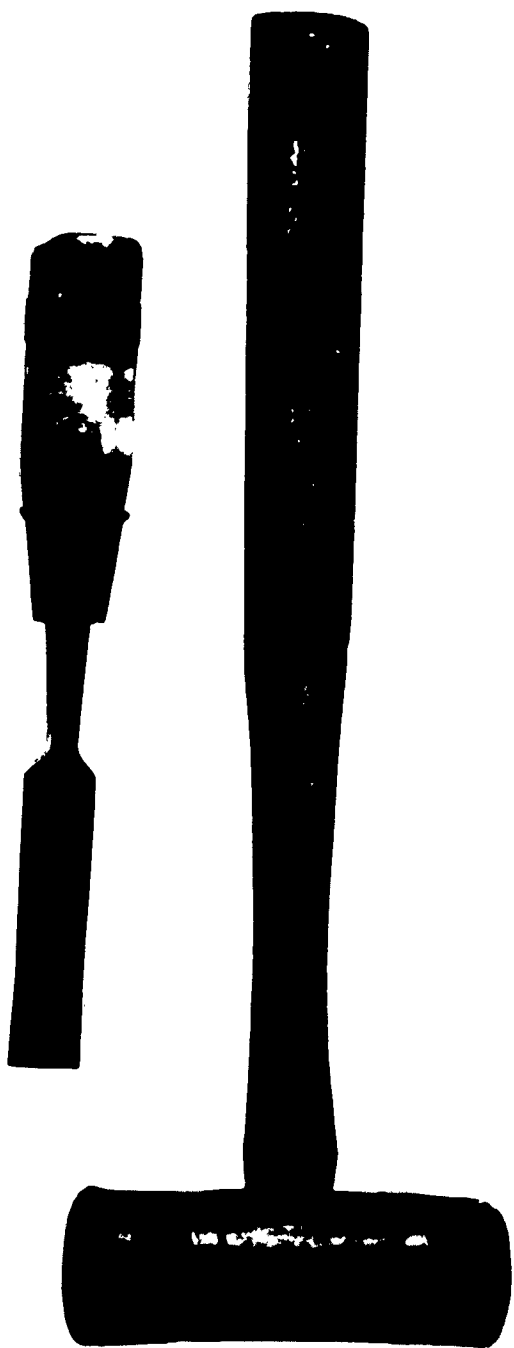


FIGURE 6. Removal Tools - M51 Nossle Closure.





FIGURE 7. Nozzle Closure - Partially Chiseled Away.

FIGURE 8. Closure Removed - Sealing Compound Exposed.



CAUTION

Go slow, make small cuts only. The graphite nozzle insert is directly behind the closure. Do not hit the graphite insert or the rokode nozzle liner with the chisel or mallet. Exercise extreme caution when nearing the sealer as a slip at this point may cut through into the rokode insulation.

After the polyurethane closure is removed exposing the sealing compound, peel the sealer from the nozzle. This can be done by lifting and pulling the edge of the sealer with the fingers and by sanding with a course and then fine sand paper. The sealer must be removed down to the rokode insulation (Figure 9). A dark discoloration of the rokode will be evident after the sealer is removed. This discoloration is normal. Do not attempt to sand it away.

CAUTION

This operation is tedious. Do not hurry. Do not use a sharp tool to remove the sealing compound as a slip may cut through the rokode insulation rendering the nozzle unserviceable.

FIGURE 9. Sealing Compound Removed - Nozzle Ready for Closure Replacement.



# REPLACEMENT PROCEDURE

The replacement procedure will require between 2 and 4 man-hours. The temperature of the blast tube and nozzle assembly and the air inside the working area should be between 60°F and 90°F.

Mask the exit cone on both sides of the area to be occupied by the closure in order to aid in applying the sealer to the proper area (Figure 10). One quarter inch wide tape should be used as narrow masking tape will be easier to apply to the tapered expansion cone surface. The dark discoloration on the roside insulation, left by the old sealer, should be used as a guide for applying the masking tape.

Obtain one nozzle closure, P/N CR 33905 from stock. Unpack the closure and examine for damage. Some closures may be found to have shallow chips or cuts in the threads. These areas should be carefully sanded smooth in order to allow easy insertion of the closure plug.

Obtain, through supply channels, one pint of sealing compound, meeting the requirements of MIL-S-8784A (FSN 8030-881-3933 Class A-1/2) (Figure 11). Mix the base material and accelerator according to the directions on the label. Make sure the accelerator is thoroughly mixed with the base material.

Using a new one inch wide paint brush, spread a fairly heavy coating of the sealer on the inner surface of the nozzle expansion cone that will mate with the closure (the area between the previously applied masking tape). The coating should cover the area thoroughly but should not be applied so thick as to cause it to run down the sides of the nozzle or drip from the top (Figure 12). Remove the masking tape from around both sides of the sealer. Do not remove the masking tape previously applied to the entire nozzle cone area.

Apply a coating of the sealer to the edge of the polyurethane closure. The coating should completely cover the edge of the closure but should not be allowed to drip down the sides (Figure 13). Make sure that two shallow grooves cut into the edge of the closure are filled with sealer.



FIGURE 10. Masking Tape Applied Around Area to Receive Sealing Compound.



FIGURE 11. Sealing Compound - MIL-S-8784A.

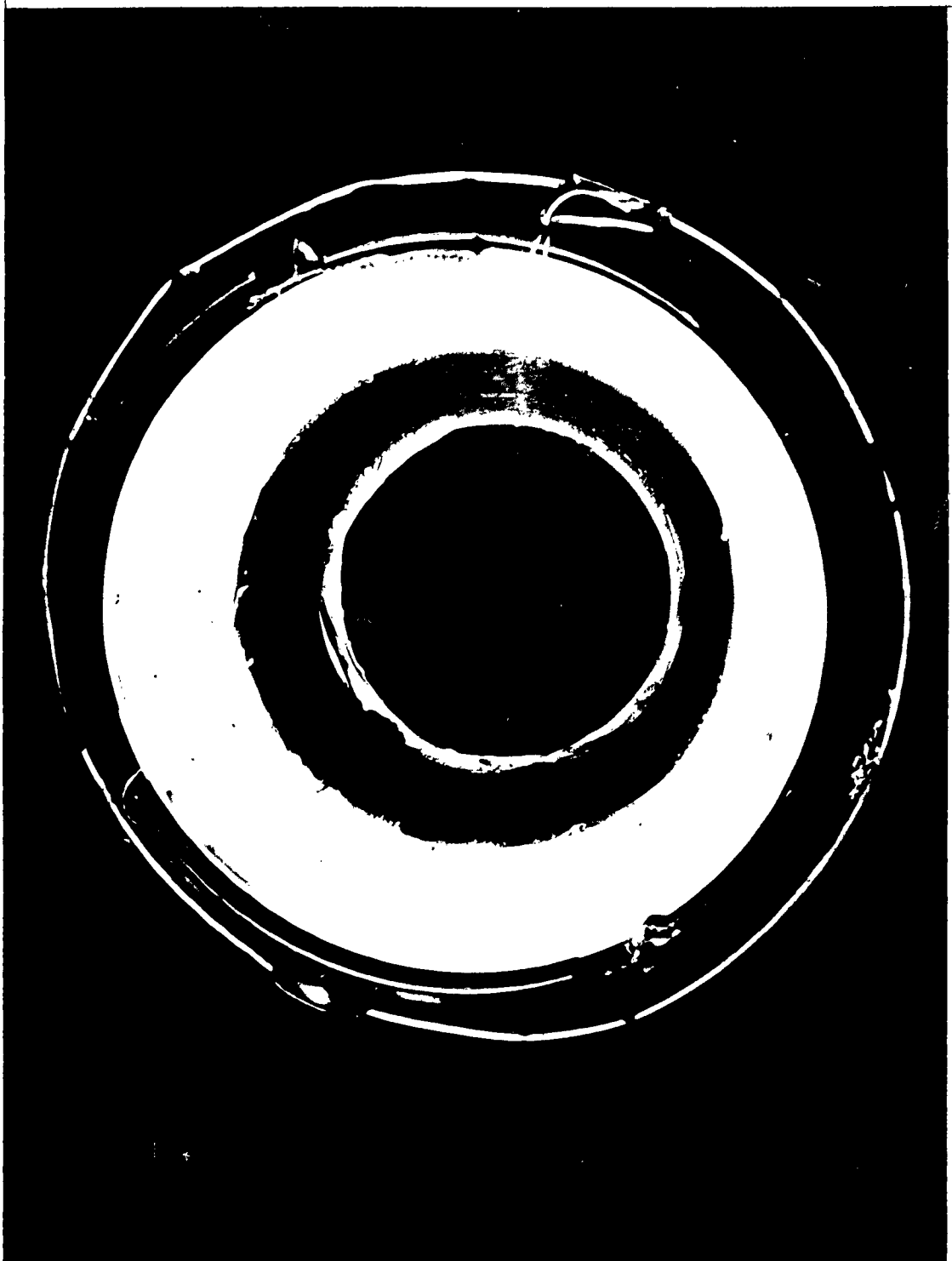


FIGURE 12. Sealing Compound Applied to Nozzle Expansion Cone.



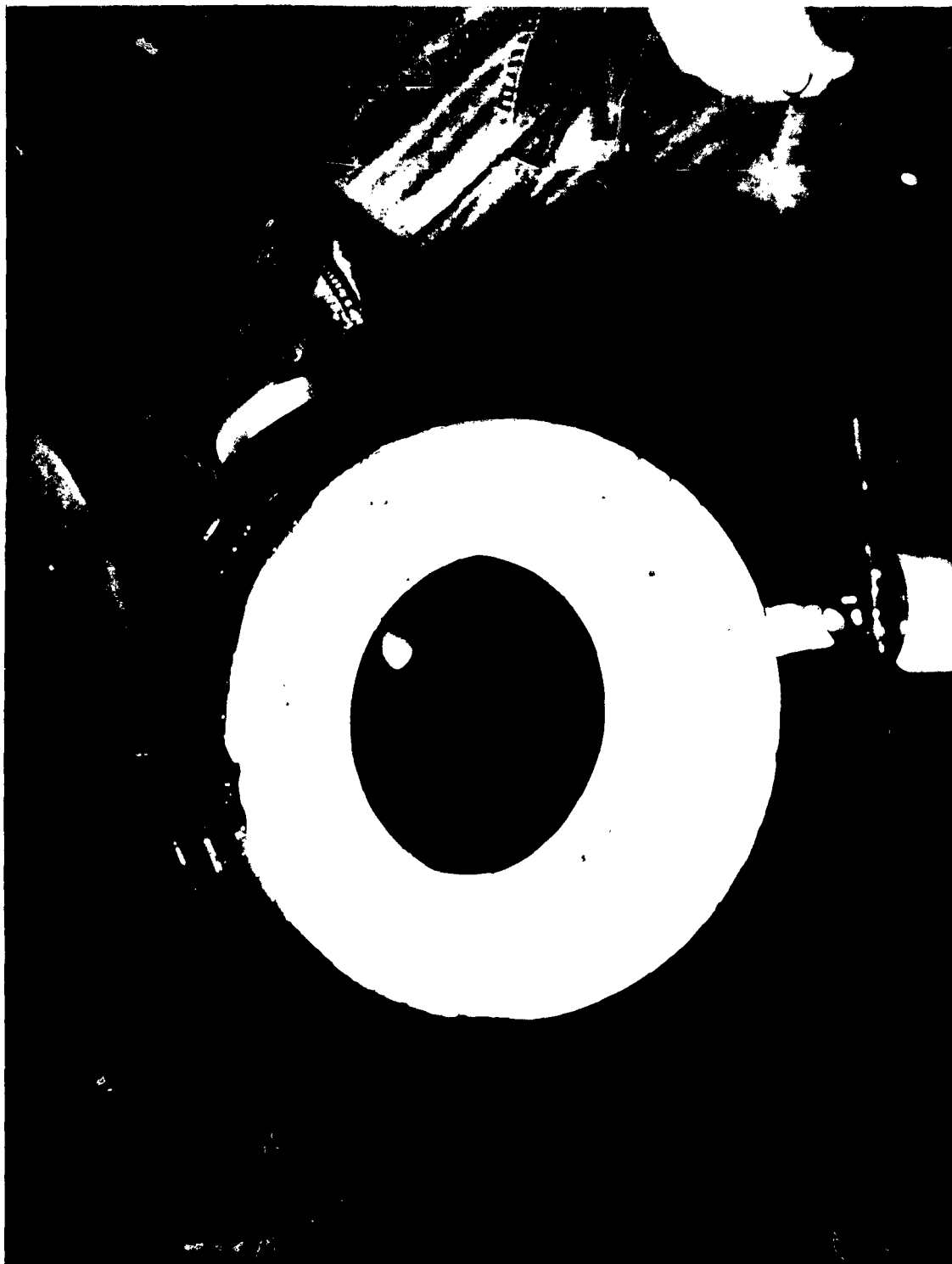


FIGURE 13. Sealing Compound Applied to Closure.

Insert the closure into the nozzle expansion cone. Avoid contact between the closure and cone surfaces until the closure seats at the back of the cone. Tap the closure lightly around the periphery with a mallet to insure that the closure is properly seated (Figure 14).

Approximately one hour after the closure has been inserted into the expansion cone remove all masking tape from the cone surface. By this time, any tendency of the sealing compound to drip or run will be over. Do not allow the masking tape to remain in the nozzle until the sealer has cured as excess sealer may bond the masking tape to the expansion cone or closure making removal difficult.

Allow the sealer to cure without disturbing the nozzle or the closure.

At an environment temperature of 60°F, a minimum of 48 hours will be required to cure the sealer. As the temperature is increased, the minimum cure time will decrease. The state of cure of the sealer can be checked by touching the exposed edge of the sealer with the fingers. The sealer, if cured, will be firm to the touch without any tendency to be tacky. The nozzle closure will be tightly bonded to the expansion cone without any noticeable movement when grasped with the hand and pulled or pushed.

As the sealer cures, a fine crack may develop at the mating edge of the closure and nozzle cone because the closure does not mate exactly with the cone. This crack, if present, will not adversely affect the sealing of the closure to the cone. Fill the crack by mixing a small amount of sealing compound and applying it to the crack with a small round camel's hair paint brush (1/8 inch diameter brush).

After the sealing compound has thoroughly cured, thread a closure plug (P/N 30034A) into the closure to complete the replacement. Before inserting the plug, spread a thin coating of silicone grease on the threads of the plug and on the plug gasket. Thread the plug into the closure hand-tight. Then tighten the plug until the gasket is firmly in contact with the closure, using a closure plug wrench, P/N 61C33791. This completes the removal and replacement procedure.

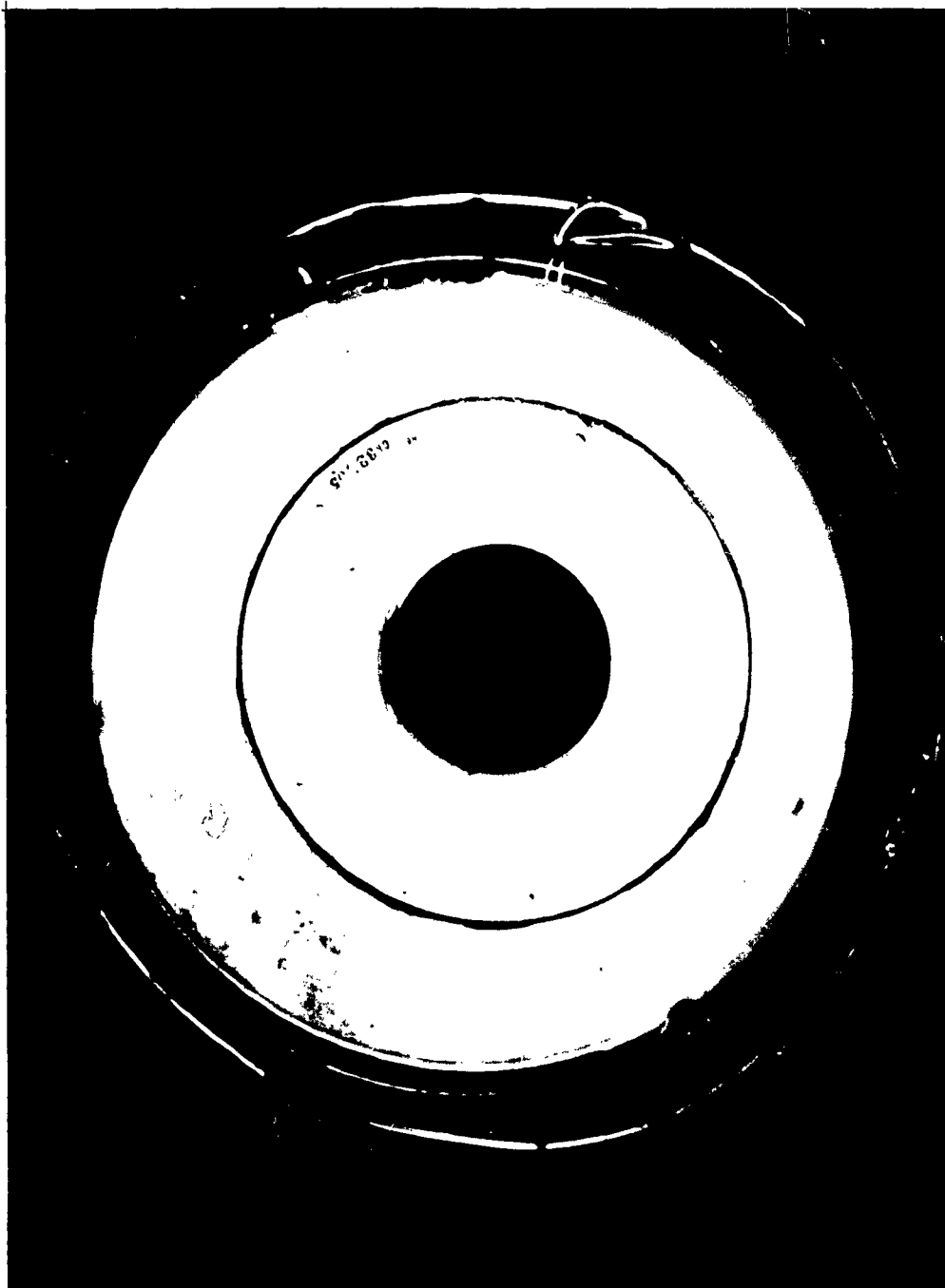


FIGURE 14. Closure Inserted Into Nozzle Expansion Cone.

## CONCLUSIONS

1. Field or depot removal and replacement of damaged IM99B Boost Motor Nozzle Closures is practical.

2. No special tools are required.

3. Necessary material (closures, plugs, sealing compound, silicone grease and paint brushes are available through normal supply channels. The nozzle closure plug wrench (Figures 4 and 5 ) is authorized for local fabrication.

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<p>AD</p> <p>2705th Aircommunications Wing (COMMA), Hill Air Force Base, Utah REMOVAL AND REPLACEMENT PROCEDURE FOR NOZZLE CLOSURE, IN998 BOOST MOTOR, by Don F. Woods, April 1963, 21p incl. figures.      Unclassified Report (OOT-TH-63-8)</p> <p>The nozzle opening of the IN998 Boost Motor (N51 Rocket Motor) is sealed by a polyurethane foam closure bonded to the nozzle expansion cone. Occasionally the closure is damaged and must be removed and replaced. The removal procedure consists of very carefully chiseling away the polyurethane foam until the bonding material is exposed. The bonding material (polyurethane sealing compound) is then removed by peeling back with the fingers and by sanding. The closure is replaced by applying a commercial sealing compound to the closure and nozzle expansion cone, inserting the closure into the cone and allowing the sealing compound to cure. Field or depot removal and replacement of damaged closures is practical. No special tools or equipment is required. Necessary material and parts are available through normal supply channels.</p>	<p>UNCLASSIFIED</p> <p>1. Rocket Motor I. Don F. Woods</p>	<p>AD</p> <p>2705th Aircommunications Wing (COMMA), Hill Air Force Base, Utah REMOVAL AND REPLACEMENT PROCEDURE FOR NOZZLE CLOSURE, IN998 BOOST MOTOR, by Don F. Woods, April 1963, 21p incl. figures.      Unclassified Report (OOT-TH-63-8)</p> <p>The nozzle opening of the IN998 Boost Motor (N51 Rocket Motor) is sealed by a polyurethane foam closure bonded to the nozzle expansion cone. Occasionally the closure is damaged and must be removed and replaced. The removal procedure consists of very carefully chiseling away the polyurethane foam until the bonding material is exposed. The bonding material (polyurethane sealing compound) is then removed by peeling back with the fingers and by sanding. The closure is replaced by applying a commercial sealing compound to the closure and nozzle expansion cone, inserting the closure into the cone and allowing the sealing compound to cure. Field or depot removal and replacement of damaged closures is practical. No special tools or equipment is required. Necessary material and parts are available through normal supply channels.</p>	<p>UNCLASSIFIED</p> <p>1. Rocket Motor I. Don F. Woods</p>
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